

بسم الله الرحمن الرحيم

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Assessment of Infection control in the Departments
Of Nuclear Medicine

تقويم مدى انتشار العدوى بأقسام الطب النووي

*A Thesis Submitted, as a partial fulfillment of aware of Master Degree in Nuclear
Medicine Technology*

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Dedication

For my dearest parents A.zainab Mokhtar Ahmed,
Dr.Mohammed Aboh Mohammed for my little brother soul
Ahmed

My supervisor Dr.Mohammed Mohammed Omer and any one
who have help me, I dedicate this work

Acknowledgement

I would like to thanks god for his help and I send greatest thanks to Dr. Mohammed Mohammed Omer for his help and support and for kindly supervising this study

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Abbreviations

FUO	Fever of Unknown Origin
Ga67	Gallium citrate 67
WBCS	White Blood Cells
QC	Quality Control
NM	Nuclear Medicine
HAIs	Health Care Associated Infections
MRSA	Multi Resistance Antibody
ACSQHC	Australian Commission on Safety and Quality in Health Care
USP	United State Pharmacopeia

In11	Indium11
DTPA	Di Tri amine Penta Acetic Acid
KGY	Kilo Gray
CT	Computed Tomography
MRI	Magnetic Resonance Imaging
U S	Ultra Sound
TC99m	Technetium per technitate
BAP	Blood Agar Plate

Abstract

Concern about the spread of infections in the hospital setting has prompted regulatory agencies to mandate infection control standards. Each hospital department is required to have written policies and procedures which describe measures to prevent and control the spread of infections (hospital acquired infections), along with quality assurance programs to assure that procedures are followed. The Department of Nuclear Medicine, as other departments, should have procedures which address special precautions for the prevention of infections. This article will focus on a new approach to prevent infections, guidelines for handling patients and contaminated equipment, and the importance of quality assurance activities to monitor compliance to established standards. An opening discussion to assess the infection control in the departments of N.M and check the contamination level in the departments by culturing samples from air and surface inside the departments of nuclear medicine.

ملخص البحث

قد أثارت المخاوف بشأن انتشار العدوى في المستشفيات الهيئات التنظيمية لتفويض معايير لمكافحة العدوى

و علي كل قسم داخل المستشفى ان يكون لديه معايير و إجراءات للسيطرة و لمنع انتشار العدوى (العدوى)

المكتسبة من المستشفيات) وان ترفق هذه المعايير والاحراءات مع برامج ضمان الجودة لضمان أن يتم اتباعها ،قسم الطب النووي و لاقسام الأخرى ينبغي أن يكون لديها إجراءات احتياطية خاصة للوقاية من العدوى. هذه الدراسة سوف تركز على اتباع طرق منع العدوى، والمبادئ التوجيهية للتعامل مع المرضى والمعدات الملوثة، وأهمية أنشطة ضمان الجودة و الامتثال للمعايير المعمول بها. وايضا مناقشة كيفية مكافحة العدوى و معدل مدي التلوث باقسام الطب النووي عن طريق تحليل عينات من الهواء والاسطح داخل قسم الطب النووي

Chapter One

(Introduction)

Chapter one

1-1Introduction:

Currently, there are a limited number of strategies available within nuclear Medicine for clinical imaging of bacterial infection (Goldsmith et al 2009).

Common indications for infection imaging include fever of unknown origin (FUO), suspected infection in prosthetic joints, post-surgical infections, and suspected infection in pulmonary, skeletal, and soft tissue locations.

The two most common protocols involve scintigraphic or single photon emission computed tomographic (SPECT) imaging of either ^{67}Ga -citrate or radiolabeled autologous white blood cells (WBCs) (Signore, and Glaudemans, 2011)

The precise mechanism of ^{67}Ga -citrate accumulation within an infection site is not known, but interactions with bacterial siderophores and/or localized leukocyte lactotransferrin proteins may play a role] (Hughes, 2003)

In the case of radiolabeled WBCs, the cells will simply traffic to sites of infection or inflammation as part of the normal host response.

Current nuclear medicine methods for bacterial infection imaging are largely based on markers of host inflammatory response including hyperaemia, increased vascular permeability, and infiltration of WBCs. Infections from bacteria, fungi, or parasites, in addition to instances of sterile inflammation, are not readily distinguishable from one another with current methods in nuclear medicine. Additionally, immunocompromised patients are the most susceptible to infectious disease, and current protocols in nuclear medicine are limited because they rely on a functional immune response. Improvements in the

specificity of nuclear probes for bacteria may extend the range of indications and applications for clinical infection imaging. Further, the development of rapid and bacteria-specific infection imaging protocols could be beneficial in instances of antibiotic resistant infections, biofilm formation, or in cases where real-time accurate infection imaging would be beneficial to guide iterative therapies. Indeed, some bacterial imaging agents with potential for improved specificity, including radiolabeled antibiotics and peptides, have been evaluated in preclinical and clinical studies (Akhtar et al 2012)

1-2-Research problem

Quality control measure are necessary to insure that a nuclear medicine department complies with all the requirement and specification laid out for it. The breach of sterility or a pyrogenicity can in turn be due to the presence of microbial organisms in nuclear medicine department. The microbiological safety of the nuclear medicine department is established by conducting sterility tests and tests for bacterial endotoxins.

1-3-Objectives:

1-3—1 General objective:

The main objective of this study is to assess the infection control in the Departments of Nuclear Medicine.

1-3-2-Specific objective:

- To assess the **infection** control in the Departments of Nuclear Medicine .
- To check the contamination level in Nuclear Medicine Departments.
- To highlight the importance of the Quality Control(QC) methods in ensuring that a NM departments complies with all the requirements and specification laid out for it.

1-4 Significant of the study:

- To explain how and when we should use the procedure of infection control as important tool in detection of contamination.
- To describe how much the culturing of sample in nuclear medicine department is accurate and sensitive for detection of bacterial infection.

1-5: over view of the study:

The researcher divided this research into five chapters according to the standard methodology basis, chapter one deal with brief introduction about the research concept , the research problem, objectives, and over view of the study ,chapter two included health care associated infection , infection control and a brief section of(sterility tests) and Literature review which are related to the research topic, chapter three included the theory of the research including the material used in detection of infection, chapter four represented the results of the research , while chapter five included discussion , conclusion and further recommendation of the study.

Chapter Two

(Literature Review)

Chapter Two

2-1 Health care associated infection:

Back ground:

Firstly, effective and timely communication, including clinical handover, is essential(ACSQHC 2009). This includes the intra-hospital transfer of patients, and the Medical Imaging department is a site of frequent patient visitations with multiple interactions involving Imaging staff members (clerical, nursing, radiographic, medical), ward staff, and transport staff. Additionally, patient information/alerts should be uniformly and readily available, for example, through electronic means, to treating healthcare workers(Kho, 2008). Sometimes, variable quality information may reside in disparate and non-integrated information systems within the healthcare organization. Imaging referral forms must contain accurate, complete and relevant information. Involvement of the patient in their own healthcare management may also help prompt appropriate clinical action.

Secondly, this case study highlights the issue of Healthcare Associated Infections (HAIs) 3. (ACSQH, 2009), (Tasmanian Infection Prevention & Control Unit,, 2009),ACSQH, 2009) And the Medical imaging department.

AHAI occurs when a patient acquires an infection as a result of receiving healthcare. HAIs acquired in the hospital setting are a major cause of death and increased morbidity for hospital patients worldwide. Multinational point prevalence studies demonstrate a HAI rate of around 8-10%⁴. It is estimated that there are 200,000 such infections in Australian hospitals annually. There are also many indirect impacts of HAIs including a reduction in throughput for elective surgery, stress and workload pressure for staff and reduced time to attend to other patients.

HAIs can occur in any patient and most commonly include urinary tract, respiratory tract, surgical site (wounds) and blood stream infections. They are the most common complication affecting patients in hospital, and involve bacterial (with or without antibiotic multiresistance) and viral infections. Healthcare workers can also be involved. MRSA is the most commonly reported multiresistant organism and is responsible for a significant burden of disease.

The prevention and management of such infections is therefore critically important. HAIs are a major and growing issue in the quality and safety of health care in both the hospital and community settings requiring urgent national consideration and action and has been nominated as a priority area by the Australian Commission on Safety and Quality in Health Care (ACSQHC). This HAI program aims to build on facility and jurisdictional initiatives to develop a national approach to reducing HAI by identifying and addressing systemic problems and gaps, and ensuring comprehensive actions are undertaken in a nationally coordinated way in both public and private health sectors.

There are five key initiatives in the overall strategy:

1. National Hand Hygiene Project (Hand Hygiene Australia <http://www.hha.org.au>, 2009),(ACSQH National Hand Hygiene Initiative, 2009)
2. National Infection Control Guidelines
3. National HAI Surveillance System
4. Building Clinician Capacity in this area
5. Antibiotic Utilisation/stewardship

In other countries recognition of the impact of HAIs is growing and considerable measures are being taken in this area(NHS UK "Healthcare associated infection" ,, 2009),(Public Health Agency of Canada 2009)

2-2Infection Control:

Infection Control in a health care facility is the prevention of the spread

Of microorganisms from:

- Patient to patient
- Patient to Staff member
- Staff member to patient

Every health care facility should have a nominated person or team to ensure Infection Control Policies and Procedures are in place.

However, all employees who have contact with patients or items used in the care of patients must adhere to Infection Control Policies and Procedures, In most health care facilities many sick people are treated or cared for in confined spaces. this means there are many microorganisms present. Patients will come into contact with many members of staff who can potentially spread the microorganisms and infections between patients.

Large amounts of waste contaminated with blood and body substances are handled and processed in health care settings increasing the risk of infection.

The following medical procedures also increase the risk of infection:

- Inserting a tube into the body to drain or deliver fluids provides a pathway through which bacteria can enter.
- Surgery requires cutting the skin which is one of the body's most important defenses against infection.
- The over-use of antibiotics have caused the development of some drug resistant bacteria that are harder to destroy.

Controlling the spread of infections in a health care facility is, therefore, very important.

The risk of people working in health care facilities getting infections from patient is very low if all staff members follow good hygiene principles and other Standard Precautions.

Standard Precautions (or Universal Precautions) are work practices that are required for the basic level of Infection Control.

They include:

- Good hygiene practices.
- Frequent hand washing.
- The appropriate use of gloves.
- The use of other personal protective equipment, such as eye protection, masks, aprons, gowns and overalls.
- The safe use and disposal of sharp instruments, such as needle and syringes.
- The use of disposable equipment where applicable and available.
- Correct cleaning, disinfection and sterilization of non-disposable equipment .
- Safe collection, storage and disposal of waste.
- Protocols for preventing and managing occupational exposures to blood or body substances.

Standard Precautions will help stop the spread of infections. Often you can't tell who is infected with a disease, or the person may be infected but have not yet developed any signs or symptoms. Some diseases can take several months before people become sick but they can still be infectious.

Therefore all body substances (except sweat and tears) of all people are considered to be potential sources of infection.

2-3Sterility Test

Sterility refers to absence of any viable bacteria or Microorganism that could develop into something living

Sterility testing is performed to prove that radiopharmaceuticals are essentially free of viable microorganisms. These tests must be performed aseptically so that external bacteria are not added to the test samples during the procedure. A laminar-flow hood is preferable, and personnel performing these tests should be well trained.

According to the USP 26, sterility tests are performed by incubating the Radiopharmaceutical sample in fluid thioglycollate medium at 30_ to 35_C for 14 days. Another test uses soybean-casein digest medium for incubation at 20_ to 25 _C for 14 days. The sample volume for the test should be at Least as great as that for a human dosage. If bacterial growth is observed in either test, the radiopharmaceutical is considered to be a sterile.

Since sterility testing frequently takes longer than the half-lives of many common short-lived radionuclides such as ^{99m}Tc , these radiopharmaceutical Preparations are tested for sterility on a post hoc basis. In these cases, the product in question is released for human use provided the manufacturer has already established its sterility and apyrogenicity at the production level. Another in vitro sterility test uses the metabolism of ^{14}C -glucose by microorganisms present in the material under test. The basic principle of the

test involves the addition of the test sample to a trypticase soybroth culture medium containing ^{14}C -glucose, then incubation, and finally collection and radioassay of $^{14}\text{CO}_2$ formed by the metabolism of microorganisms, if present, in the sample. Radioassay is done with a gas ionization chamber and both aerobic and anaerobic microorganisms can be detected by this method. Automated instruments using this principle are commercially available. This method is useful, particularly because it requires only a short amount of time, about 3 to 24 hr, compared to many days in other methods approved by the USP.

All preparation for human administration must be sterilized by suitable method that depend on the nature of the product ;the solvent and ,various additives. Assessment of sterility is most commonly performed by culturing sample with special growth media.

There are four method of sterilization used in pharmaceutical practice:

Sterilization by moist heat

The item to be sterilized is placed in an autoclave in which steam is generated¹⁵ under pressure to produce sterilizing heat. Temperature of 115°C for 30min or 121°C for 15min are satisfactory for sterilization. This method is reliable for the sterilization of thermostable aqueous solution, whereas oil- based preparation and heat labile radiopharmaceutical such as many $\text{Tc}^{99\text{m}}$ -labelled preparation and iodinated proteins cannot withstand autoclaving because the molecule would be damage by heat . autoclaving is also not suitable for short - lived radio nuclides such as $\text{In}^{113\text{m}}$ and F^{18} because it take too long.

Thermo stable radiopharmaceuticals include Tc99m-pertechnetate, In111-DTPA, Ga67-galliumcitrate, and In111chloride. These compound may also be sterilized by dry-heat sterilization and gamma –radiation. A trace of moisture must always be left in capped container for satisfactory sterilization.

Sterilization by dry heat

Item are subjected to a temperature of 160c for 1h. This method rarely used for radiopharmaceutical, but is valuable method for the sterilization of glassware.

Sterilization by membrane filtration

This method is applicable only to solutions and is carried out by passing the solution through a sterile membrane filter

That removes various organisms by sieving mechanism in to an aseptic container. These membrane filters are made from cellulose esters or polycarbonate, and are available in various pore sizes and disposable units. The most common membrane filter size is 0.45micrometer, but membrane with a pore size of 0.22micrometer are advised for sterilization of blood products and preparation suspected of contamination with smaller microorganisms.

This is the most common method of sterilization in radiopharmaceutical industry and is the method of choice for Short-lived radio nuclides and heat labile radiopharmaceuticals. Another type of filter, nuclepore, is available. It is primarily used for the determination of particle size in colloidal preparation and is not used for sterilization purposes.

Radiation Sterilization

Item to be sterilized exposed to 25 to 30 KGY of gamma radiation. It is a great value for the sterilization of disposable plastic syringes and other items, which may be used in radiopharmaceutical preparations

Apyrogenicity:

All radiopharmaceuticals for human administration are required to be pyrogen free. Pyrogens are either polysaccharides or proteins produced by the metabolism of microorganisms. They are 0.05 to 1 mm in size, and in general, are soluble and heat stable. Bacterial products, the so-called endotoxins, are the prime examples of pyrogens, but various chemicals also can add pyrogens to a radiopharmaceutical solution. Following administration, pyrogens produce symptoms of fever, chills, malaise, leukopenia, pain in joints, flushing, sweating, headache, and dilation of the pupils.

Advantages of nuclear medicine technique

Nuclear medicine has an important role in adding the diagnosis of particularly deep seated infections such as abscesses, osteomyelitis, septic arthritis, endocarditis and infections of prosthetic devices. It provides information on pathophysiological and pathobiochemical processes. In this respect it differs from other current imaging procedures such as x-ray, CT and MRI, which supply information with high resolution on the morphological changes that occur in a specific disease. In addition, nuclear medicine technique permits whole-body imaging, whereas CT and MRI routinely focus on just a part of the body. Nuclear medical from inflammation imaging has an important role in discriminating infections from Inflammation. Inflammatory processes can be visualized in their early phases, when anatomical changes are not yet apparent. The early detection of the infectious focus by radionuclide imaging helps both patient and physician to reduce the cost and the length of hospitalization.

2-4-Previous study

El-Ghany et al.,(2005),Despite the advances in public health during the 18th and 19th centuries and the introduction of immunization and antibiotics in the 20th century, bacterial infection is among the most frequently encountered and costly causes of diseases and one of the major cause

Hall et al,(1998) Localizing and distinguishing the “infection foci” in body sites are very important and life saving processes. The identification of an infection at early stage of disease is critical for a favorable outcome. The diagnosis of deep seated infections such as osteomyelitis, endocarditis and intra-abdominal abscesses is still a challenging problem. Although imaging techniques such as x-ray, computerized tomography (CT-scan), magnetic resonance imaging (MRI) and ultrasonography (US) might be helpful, but none of these techniques are specific for infection diagnosis because of their limitations due to insignificant anatomical changes in the early stages of the infection process. In addition, these techniques are not capable of differentiating between inflammatory and infectious processes. In contrast, nuclear medicine procedures can determine the location and the degree of disease activity in infectious processes based on physiologic and/or metabolic changes that are associated with the importance of diseases rather than gross changes in the structure.

Welling et al., (2001) This method requires a reliable radiopharmaceutical that can selectively concentrate in sites of infection. Various ^{99m}Tc -labeled compounds have been developed for the scintigraphic detection of infection and sterile inflammation in humans. Unfortunately, these radiopharmaceuticals do not discriminate between infection and sterile inflammatory process, which is often of clinical importance.

Oyen et al., (2005) In recent years, the development of radiolabeled antimicrobial agents for specific diagnosis of infection has received considerable attention, sparking a lively debate about the infection specificity of these radiopharmaceuticals.

Direct targeting of the locally present microorganisms is a new approach for improving the selectivity of radiopharmaceuticals for infection detection in nuclear medicine .

Kyprianidou et al., 2011 The use of radiolabeled antibiotics and antimicrobial peptides are fast emerging as promising targeted diagnostic tests for detection of infective lesions because of their specific binding to the bacterial component. These targeting molecules reliably locate sites of infection and make a differential diagnosis between infection and sterile inflammation

Chapter Three

(Materials and Methods)

Chapter three

3-1 Material and experimental Method

This chapter presents the method and specification of the material used to collect the data as well as the technique used to acquire the data.

The data was collected from nuclear medicine department at Radiation and Isotope center of Khartoum (RICK) and Alneleen medical diagnostic center the data was acquired from air and surface in the period from august 2014-may 2015 .

3-2 Material

Eleven Dishes contain blood agar for culturing samples.

3-2-1 Petri dish

A Petri dish (sometimes spelled "Petrie dish" and alternatively known as a Petri plate or cell-culture dish), named after the German bacteriologist Julius Richard Petri[^](Petri dish in the American Heritage Dictionary), is a shallow cylindrical glass or plastic lidded dish that biologists use to culture cell (sElsevier. 2008.) – such as bacteria – or small mosses (*Botanica Acta* 111 1998)

Modern Petri dishes usually feature rings made from glass or plastic While glass Petri dishes may be reused after sterilization (via an autoclave or one hour's dry-heating in a hot-air oven at 160 °C, for example), plastic Petri dishes are often disposed of after experiments where cultures might contaminate each other.

3-2-2 Microbiology

Petri dishes are often used to make agar plates for microbiology studies. The dish is partially filled with warm liquid containing agar and a mixture of specific ingredients that may include nutrients, blood, salts, carbohydrates, dyes, indicators, amino acids or antibiotics. Once the agar cools and solidifies, the dish is ready to be inoculated ("plated") with a microbe-laden sample. Virus or phage cultures require a two-stage inoculation: after the agar preparation, bacteria are grown in the dish to provide hosts for the viral inoculum.

Petri plates are incubated upside-down to lessen the risk of contamination from airborne particles setting on them and to prevent the accumulation of any water condensation that may otherwise disturb or compromise a culture.

Scientists have been growing cells in natural and synthetic environments to study phenotypes that are not expressed on [conventionally rigid substrates] growing cells either on or in Petri dishes can, however, be an expensive and labor-intensive undertaking. (Gilbert, P.M. et al. 2010) (Chowdhury, F et al (2010).)

Petri dishes are also used for eukaryotic cell culture in a liquid medium or on solid agar. Empty Petri dishes may be used to observe plant germination, the behavior of very small animals or for other day-to-day laboratory practices such as drying fluids in an oven and carrying or storing samples. Their transparency and flat profile also mean they are commonly used as temporary receptacles for viewing samples, especially liquids, under a low-power microscope.

3-2-3 Agar plate

In 1881, Fannie Hesse, who was working as a technician for her husband Walther Hesse in the laboratory of Robert Koch, suggested agar as an effective setting agent, since it had been commonplace in jam making for some time.(from the original on 11 February 2010. Retrieved 2010-02-22.)

An **agar plate** is a Petri dish that contains a growth medium (typically agar plus nutrients) used to culture microorganisms or small plants like the moss *Physcomitrella patens*.(Madigan M and Martinko J 2005)

Selective growth compounds may also be added to the media, such as antibiotics.

Individual microorganisms placed on the plate will grow into individual colonies, each a clone genetically identical to the individual ancestor organism (except for the low, unavoidable rate of mutation). Thus, the plate can be used either to estimate the concentration of organisms in a liquid culture or a suitable dilution of that culture using a colony counter, or to generate genetically pure cultures from a mixed culture of genetically different organisms, using a technique known as "streaking". In this technique, a drop of the culture on the end of a thin, sterile loop of wire, sometimes known as an inoculator, is streaked across the surface of the agar leaving organisms behind, a higher number at the beginning of the streak and a lower number at the end. At some point during a successful "streak", the number of organisms deposited will be such that distinct individual colonies will grow in that area which may be removed for further culturing, using another sterile loop.

3-3-3Blood agar plate (BAP)

Blood agar plates (BAPs) contain mammalian blood (usually sheep or horse), typically at a concentration of 5–10%. BAPs are enriched, differential media used to isolate fastidious organisms and detect hemolytic activity. β -hemolytic activity will show lysis and complete digestion of red blood cell contents surrounding colony. Examples include *Streptococcus haemolyticus*. α -hemolysis will only cause partial lysis of the red blood cells (the cell membrane is left intact) and will appear green or brown, due to the conversion of hemoglobin to methemoglobin. An example of this would be *Streptococcus viridans*. γ -hemolysis (or nonhemolytic) is the term referring to a lack of hemolytic activity. BAPs contain meat extract, tryptone, sodium chloride, and agar.

3-4-3Three swab

Swab is a wad of cotton, gauze, or other absorbent material attached to the end of a stick or clamp, used for applying or removing a substance from a surface .

A small piece of absorbent material attached to the end of a stick or wire and used for cleansing a surface, applying medicine, or collecting a sample of a substance.

3-4-1Definition of swab method in microbiology :

Swab method is a method used to pick up microflora from surfaces especially from smooth surfaces like metals, plastic and glass on which the ordinary loop would be ineffective. it can be used to qualify as well as to quantify the flora on a given surface area.

3-4-2The Swab Check principle

The surface is wiped with a cellulose swab and any bacteria collected are transferred via the swab into a tube containing a special medium with an indicator dye, which is then incubated. A single bacterium is sufficient to cause a color change. This means that SwabCheck is about 1000 times more sensitive than the conventional method. this accuracy is particularly important in the food industry. With this simple method, it is possible to identify microorganisms such as *Listeria monocytogenes*, which must not be present in any concentration in food and beverages.

3-4-3Methods

Open the sterile pack, remove the swab and wipe it over an area of about 10 x 10 cm .then twist off the cap of the medium tube and insert the swab so that the cap fits tightly. Label the sample tube and incubate at the appropriate temperature.

A change in color indicates the presence of the microorganism in question. The quicker the color change occurs, the higher the bio burden. If no color change has been observed after the maximum incubation period has elapsed, then the corresponding microorganism is not present.

This method is applicable to the procedures used for examination of environmental samples including swabs from carcasses in meat processing plants, swabs of food preparation ,surfaces and other environmental samples such as cloths collected from the food manufacturing environment and bottle rinses. This support method must be used in conjunction with accredited methods for the detection of bacteria in foods and includes the use of three different types of swab.

These methods are well referenced and represent a good minimum standard for food, water and environmental microbiology. However, in using Standard Methods, laboratories should take account of local requirements and it may be necessary to undertake additional investigations.

The performance of a standard method depends on the quality of reagents, equipment, commercial and in-house test procedures. Laboratories should ensure that these have been validated and shown to be fit for purpose. Internal and external quality assurance procedures should also be in place

Samples and Types of Bacteria Testing Services

Air Samples for Bacteria Testing

Air is impacted on agar media such as nutrient agar (NA). Once the samples are sent back to the lab the media is incubated at 37°C for 24-48 hours (depending on how fast the bacteria grow). Bacteria colonies are counted and reported as colony forming units (CFU) per cubic meter of air. Transfer to ID media is performed if identification to species is required. This test reveals if the air is contaminated with types of bacteria that are of healthy concern.

Surface Samples for Bacteria Testing

Surface bacterial samples may be taken with culture-swabs, wipes or contact plates. The samples may be taken from any kind of surface (dry/wet) suspected of bacterial contamination. Surface samples for bacteria testing may also be collected to assess the efficacy of antimicrobial agents. Both quantification and identification of the types of bacteria present in the sample are possible.

Laboratory Bacteria Testing Services

Bacteria testing can determine the types and numbers (in terms of colony forming units) of bacteria present in a sample. The testing could be focused on a specific type of bacteria, medical bacteria or a broad range of environmental bacteria.

Since bacteria are present in virtually any environment, it's important to be clear why the testing is being performed. The more specific the testing, the better and easier it is to interpret the results.

Numbers and types of bacteria that should be a cause for concern depends upon several factors, including the type of bacteria present and the type of samples. For example, there should be no indicators of fecal contamination in drinking water.

Chapter Four

(Results)

Chapter four

Result

This chapter represents the results of the research.

Result of sampling culture of bacteria in Nuclear Medicine Department (Radiation and isotope centre Khartoum-RICK), from air pre and post cleaning

Table (4-1) shows type of microorganism Pre cleaning

Label of sample	Result of culture
A	Bacillus+Micrococccus+funga
B	Bacillus+ Micrococccus
C	Bacillus+Micrococccus+funga
D	Bacillus+ Micrococccus

Table (4-2) shows type of microorganism Post cleaning

Label of sample	Result of culture
A	Bacillus+Micrococccus+fungal
B	Bacillus+Micrococccus+fungal
C	Bacillus+Micrococccus
D	Bacillus+ Micrococccus+fungal+fungal

Sample (A) represent the area behind the lead shield of generator.

Sample (B) represent the area behind the generator.

Sample (C) represents the injection room area.

Sample (D) represent the weating room of injected patient .

Result of sampling culture of bacteria in Nuclear Medicine Department
(Alneleen Medical diagnostic center-Khartoum) from swabs and air

Table (4-3) *type of microorganism from Swabs*

label of sample	Result of culture
A	No growth(sterile)
B	No growth(sterile
C	No growth(sterile

Table (4-4) *type of microorganism from Air*

Label of sample	Result of culture
A	No growth(sterile
B	No growth(sterile)
C	No growth(sterile

Sample (A) represent the area behind the generator.

Sample (B) represent the area behind the lead shield of generator.

Sample (C) represents the injection room area.

Chapter Five

**(Discussion, Conclusion and
Recommendations)**

Chapter five

Discussion, Conclusion and Recommendation

This part intended to provide details of discussion, conclusion recommendation and future work.

5-1 Discussion

Tests of sterility and the absence of pyrogens are used to insure the microbiological safety , any breach of sterility or apyrogenicity can in turn be due to the presence of microbial organism . Hence,in the nuclear medicine departments it needs to be certified for microbiological safety. The microbiological safety of the the departments is established by conducting sterility tests and test of bacterial indotoxins.

The agar plates and the tubes are covered ,placed in an incubator and monitored daily for any growth. The absence of growth indicates adequate sterility of the product.

This Study was provided, and attempts to bridge the gap between the bacterial infection imaging efforts of the clinical nuclear medicine. While these disciplines are closely related, research has been conducted mostly by separate, dedicated infection imaging groups in each of these two arenas. Bacterial infection imaging in nuclear imaging is a seasoned discipline with a relatively large catalogue of imaging agents. A large body of research exists for each bacterial infection imaging agent employed in nuclear medicine.

So that in this study the result of culturing sample at nuclear medicine department in (RICK) showed that the area behind the Lead Shield is contaminated by Bacillus +Micrococccus +fungal before cleaning and contaminated with the same type after cleaning, the area behind the generator contaminated by Bacillus+ Micrococccus before cleaning and Bacillus +Micrococccus +fungal after cleaning the injection room are contaminated by Bacillus+ Micrococccus + fungal before cleaning and Bacillus+ Micrococccus

after cleaning and the waiting Room of injected patient is contaminated Bacillus+ Micrococcus before cleaning and Bacillus+ Micrococcus + fungal after cleaning, this represents that this department is not sterilized.

On the other hand the result of culturing sample from nuclear medicine department in Al Nileen medical diagnostic center-Khartoum shows that the area behind the Lead Shield, behind the generator, and the injection room of patient is sterile because there is no any type of bacteria detected in this department from air and swab so that the department is sterilized.

5-2 Conclusion

Healthcare Associated Infections are a major public health concern, and all stakeholders are paying serious attention.. Medical Imaging departments and staff need to understand these important issues, and actively participate in solutions to reduce the risk to the patients.

Written infection control policies and procedures specific for nuclear medicine shall be promulgated, made accessible, and disseminated in departments where nuclear medicine procedures are performed.

These policies shall outline procedures to be followed in the event of a potential emergency (e.g., an administration error).

5-3Recommendation

- It is important to be aware of and comply with infection control policies and procedures that reflect current best practice and standards.
- Sterile equipment as appropriate, Medical Imaging equipment may harbor potential pathogens.
- Wear personal protective equipment appropriately and correctly.
- Always perform hand hygiene after removing personal protective equipment.
- Hands shall be washed before and after patient contact, Hands shall be washed before and after using restrooms, and after removing gloves.
- All healthcare providers, including those who perform nuclear medicine procedures, shall receive training and routine in service education on proper infection control procedures.
- Paper towels shall be placed between the velcro straps and the patient's head.
- Follow manufacturers' instructions for cleaning and maintaining noncritical medical equipment.
- Keep housekeeping surfaces (e.g., floors, walls, tabletops) visibly clean On a regular basis and clean up spills promptly.
- Avoid large-surface cleaning methods that produce mists or aerosols, or disperse dust in patient-care areas
- Use standard cleaning and disinfection protocols to control environmental contamination .
- Environmental-surface culturing can be used to verify the efficacy of hospital policies and procedures before and after cleaning.

Appendices

Appendices

Sampling culture of bacteria in Nuclear Medicine Department (Radiation and isotope centre Khartoum-RICK)



Fig (3-1)

Samples before culturing



Fig (3-2)

Sample(A):behind the Lead Shield

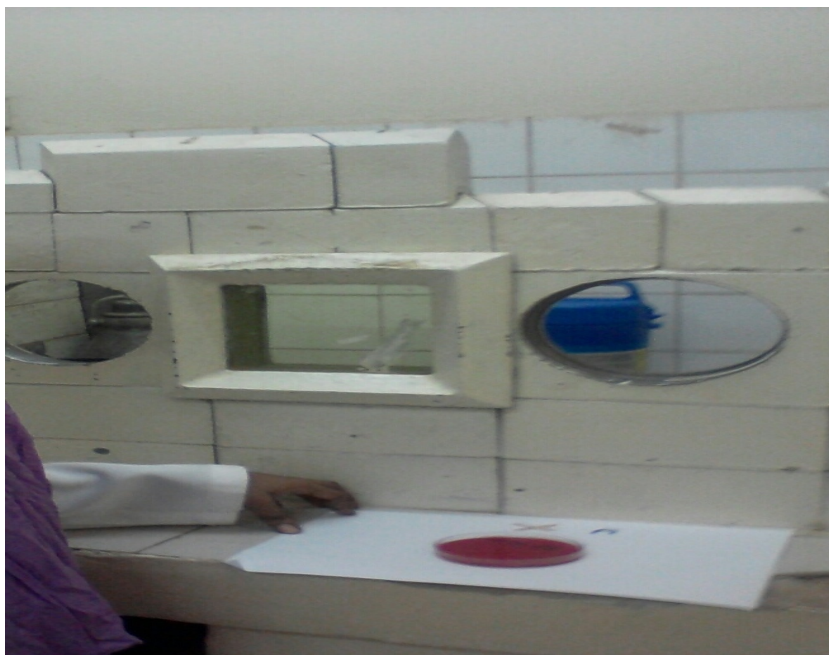


Fig (3-3)

Sample(A):behind the Lead Shield



Fig (3-4)Sample(B)

Sample(B): behind the generator



Fig (3-5)



Fig (3-6) **Sample(C)**

Sample(C):in the injection room



Fig (3-7) Sample(D)

Sample(D):in the wetting Room of injected patient.

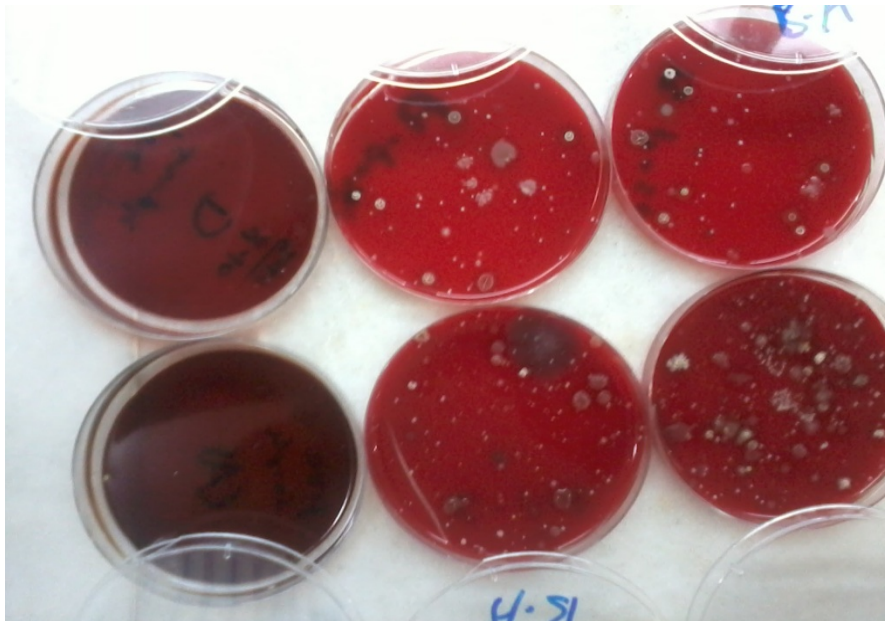
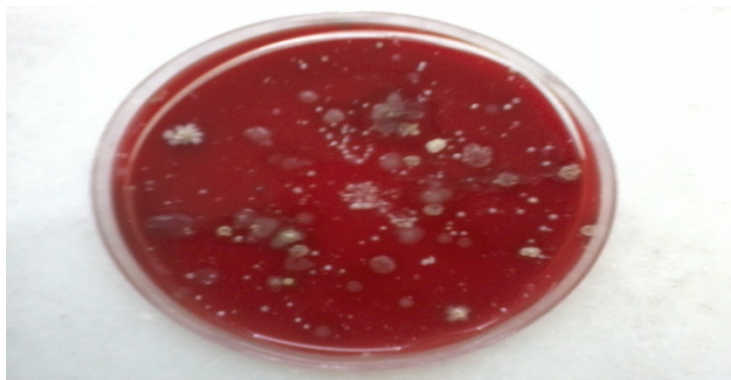


Fig (3-8)

Samples after culturing



Fig(3- 9)



Fig(3- 10)

Sampling culture of bacteria in Nuclear Medicine Department (Alneleen Medical Diagnostic center-Khartoum)



Fig(3- 11)

Sample (A): behind the generator



Fig(3- 12)

Sample (B) behind the shield of generator



Fig(3-13)

Sample(C)at the injection room

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